



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/024,208	12/21/2001	David J. Cooperberg	015290-546	9076

7590

09/09/2004

Peter K. Skiff
BURNS, DOANE, SWECKER & MATHIS, L.L.P.
P.O. Box 1404
Alexandria, VA 22313-1404

EXAMINER

ALEJANDRO MULERO, LUZ L

ART UNIT	PAPER NUMBER
----------	--------------

1763

DATE MAILED: 09/09/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/024,208	Applicant(s) COOPERBERG ET AL.	
	Examiner Luz L. Alejandro	Art Unit 1763	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 15 June 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-15 and 39-61 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-15 and 39-61 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 42, 48-50, 55, 61 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The specification, as originally filed, does not described, a first ***optional*** gas outlet, as claimed in claim 42.

The specification, as originally filed, does not described the total number of the off-axis outlets being 8, as claimed in claim 49.

The specification, as originally filed, does not described that the common gas supply comprises **a single third gas line in fluid communication with the first gas line and the second gas line**, as claimed in claim 50.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 42, 48, 50, 55, 61 50 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The specification, as originally filed, does not described, a first **optional** gas outlet, as claimed in claim 42.

In claim 42, the phrase a first **optional** gas outlet is not clear. Is applicant trying to claim that the gas outlet is optional or that the first gas is optional?

In claim 50 the phrase the common gas supply comprises a **single third gas line in fluid communication with the first gas line and the second gas line** is not clear. How a single third gas line is in fluid communication with the first gas line and the second gas line?

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was

not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1-7, 9, 11-14, 39, 41-50, and 56-61 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang, WO 99/57747 in view of Murugesh et al., U.S. Patent 6,450,117 and Arami et al., U.S. Patent 5,958,140, or Goodyear et al., U.S. Patent 5,532,190, or Ballance et al., U.S. Patent 6,090,210.

Chang shows the invention substantially as claimed including a high density plasma chemical vapor deposition system comprising: a plasma processing chamber 38; a vacuum pump system 40 connected to the processing chamber; a substrate support 56 on which a substrate is processed within the processing chamber; a dielectric member 50 having an interior surface facing the substrate support, wherein the dielectric member forms a wall of the processing chamber; a gas injector extending through the dielectric member such that a distal end of the gas injector body is exposed within the processing chamber and comprising a plurality of gas outlets 96/98 including at least one on-axis outlet 96 in the axial end surface and a spaced-apart off-axis outlet 98 in the side surface; a first gas line and a second gas line, the first gas line being in fluid communication with the on-axis outlet but not with the off-axis outlet and the second gas line being in fluid communication with the off-axis outlet but not with the on-axis outlet; flow controllers operable to supply the process gases at flow rates that are independently varied between the on-axis outlet and the off-axis outlets into the

processing chamber; a network of valves and throttling elements to vary the gas flow independently between the on-axis outlet and the off-axis outlets; and an RF energy source 89 which inductively couples RF energy through the dielectric member and into the chamber to energize the process gas into a plasma state to process the substrate. Additionally, note that the gas injector comprises an injector body including at least first and second gas inlets, at least first and second gas passages, and at least first and second gas outlets, the first gas passage being in fluid communication with the first inlet and first outlet, and the second gas passage being in fluid communication with the second inlet and second outlet, the first and second gas passages not being in fluid communication with each other. For a complete description of the apparatus see, for example, figs. 1 and 7, and their descriptions.

Chang does not expressly disclose that the plurality of gas outlets includes at least one on-axis outlet in the axial end surface and a plurality of spaced-apart off-axis outlets in the side surface. Murugesh et al. discloses an apparatus comprising a gas injector, the gas injector comprising a body including an axial end surface exposed within the processing chamber, a side surface extending axially from the axial end surface, and a plurality of gas outlets 85/247 including at least one on-axis outlet 85 in the axial end surface and a plurality of circumferentially spaced-apart off-axis outlets 247 in the side surface; a first gas line and a second gas line, the first gas line being in fluid communication with the on-axis outlet but not with the off-axis outlets and the second gas line being in fluid communication with the off-axis outlets but not with the on-axis outlet; wherein the outlets are disposed within the chamber and below the

Art Unit: 1763

chamber ceiling (see, for example, figs. 2a, 2b and 3, and their description, and col. 2, lines 51-55). Therefore, in view of this disclosure, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the apparatus of Chang as to comprise the gas injector disclosed by Murugesh et al. in order to optimize the delivery of gas(es) into the chamber and in order to direct gas preferentially across a surface of the chamber.

Chang and Murugesh et al. do not expressly disclose a common gas supply in fluid communication with the first gas line and the second gas line. Arami et al., Goodyear et al., and Ballance et al., disclose an apparatus comprising a gas injecting system in which a common gas supply 41,42,43/ 55,56 / 314 is in fluid communication with a first gas line 38/ 21 /312 and a second gas line 39/ 22 / 310, the first gas line being in fluid communication with a first outlet and the second line being connected to second outlets, wherein the first line is in fluid communication with the first outlet but not with the second outlets and the second gas line being in fluid communication with the second outlets but not with the first outlet (see, for example, fig. 2 of Arami et al. and its description, fig. 1 of Goodyear et al. and its description, and fig. 8 of Ballance et al. and its description). Therefore, in view of these disclosures, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the gas supply system of the apparatus of Chang modified by Murugesh et al. so as to comprise a common gas supply in fluid communication with the first gas line and the second gas line, in order to enable the injection of the same gas, to the processing chamber, through the on-axis outlet and the off-axis outlets. Furthermore, note that all the

references disclose the use of flow controllers operable to supply the process gas from the common gas supply at flow rates that are independently varied toward the first line and the second line. Also, Arami et al. and Goodyear et al. disclose the use of a network of gas valves and throttling elements to independently vary the gas flow. Additionally, Arami et al. discloses a single third gas line in fluid communication with the first gas line and the second gas line

Additionally, note that the apparatus of Chang modified by Murugesh et al.:

- a) comprises an RF energy source comprising an RF antenna 78, b) the gas injector injects the process gas toward a primary plasma generation zone in the chamber, c) the first gas line is in fluid communication with an axially extending central bore in the injector body, and the second gas line is in fluid communication with an annular gas passage surrounding the central bore, d) the injector body is cylindrical shaped and the off-axis outlets are circumferentially spaced apart, e) the gas injector can inject the process gas at subsonic, sonic or supersonic velocity, f) the on-axis outlet and the off-axis outlets are oriented at different angles relative to an exposed surface of the substrate, g) the plurality of gas outlets will be located/disposed within the processing chamber and below the interior surface of the dielectric member, and h) at least one of the on-axis and the off-axis outlets has a uniform diameter along the entire length thereof.

With respect to the off-axis gas outlets injecting process gas at an acute angle relative to the plane parallel to the exposed surface of the substrate, it should be noted that Murugesh et al. discloses that the gas injection angle from the off-axis gas outlets

can be greater than or less than 90 degrees relative to the plane parallel to the exposed surface of the substrate, and that the gas injection angle is chosen depending on the pre-selected regions to which the gas is desired to be injected (see, for example, col. 6, lines 56-60). Therefore, it would have been an obvious choice of design to one having ordinary skill in the art at the time the invention was made to made the off-axis gas outlets so that they inject process gas at an acute angle relative to the plane parallel to the exposed surface of the substrate in order to inject gas into specific/desired chamber regions.

With respect to the system being a plasma etching system, it should be noted that such limitation is directed to a method limitation instead of apparatus limitation and since an apparatus is being claimed as the instant invention, the method teachings are not considered to be the matter at hand, since a variety of methods can be done with the apparatus. The method limitations are viewed as intended uses which do not further limit, and therefore do not patentably distinguish the claimed invention. The apparatus of Chang modified by Murugesh et al. is capable of performing an etching process if such method is desired to be performed in the apparatus.

With respect to claim 49, note that Murugesh et al. discloses the use of more than two circumferentially spaced apart off-axis outlets. Furthermore, a prima facie case of obviousness still exists because it would have been an obvious choice of design to one of ordinary skill in the art to optimize the total number of off-axis outlets during routine experimentation depending upon, for example, the desired locations to which

the gas is desired to be injected, and would not lend patentability to the instant application absent the showing of unexpected results.

Claims 8, 10 and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang, WO 99/57747 in view of Murugesh et al., U.S. Patent 6,450,117 and Arami et al., U.S. Patent 5,958,140, or Goodyear et al., U.S. Patent 5,532,190, or Ballance et al., U.S. Patent 6,090,210, as applied to claims 1-7, 9, 11-14, 39, 41-50, and 56-61 above, and further in view of Ni et al., WO 00/41212.

Chang, Murugesh et al., Arami et al., Goodyear et al. and Ballance et al. are applied as above but do not expressly disclose that the gas injector is removably mounted in the dielectric window. Ni et al. discloses an apparatus comprising a gas injector removably mounted to a dielectric window, the reference also discloses that the most preferred mounting arrangement for the gas injector is a removable mounting arrangement (see page 13-line 20 to page 14-line 2). Therefore, in view of this disclosure, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the apparatus of Chang modified by Murugesh et al. and Arami et al., Goodyear et al. or Ballance et al., as to removably mount the gas injector to the dielectric member because such mounting arrangement is suitable and preferred, and also, cleaning of the gas injector can be facilitated.

Claims 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang, WO 99/57747 in view of Murugesh et al., U.S. Patent 6,450,117 and Arami et

al., U.S. Patent 5,958,140, or Goodyear et al., U.S. Patent 5,532,190, or Ballance et al., U.S. Patent 6,090,210, as applied to claims 1-7, 9, 11-14, 39, 41-50, and 56-61 above, and further in view of Powell et al., U.S. Patent 6,287,643.

Chang, Murugesh et al., Arami et al., Goodyear et al. and Ballance et al. are applied as above but do not expressly disclose that the gas injector is further provided with an electrically conducting shield. Powell et al. discloses an apparatus comprising a gas injection tube 84 provided with an electrically conducting shield (see col. 9, lines 33-50) that minimizes plasma ignition until the gas reaches the main chamber (see Fig. 5 and col. 7-line 57 to col. 9-line 50). Therefore, in view of this disclosure, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the apparatus of Chang modified by Murugesh et al. and Arami et al., Goodyear et al. or Ballance et al., so as to further comprise an electrically conducting shield for the gas injector in order to minimize the plasma ignition within the injector because plasma ignition within the injector can result in detrimental effects such as damage to the injector as well as uniformity problems with processing within the chamber.

Claims 51-55 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang, WO 99/57747 in view of Murugesh et al., U.S. Patent 6,450,117 and Arami et al., U.S. Patent 5,958,140, or Goodyear et al., U.S. Patent 5,532,190, or Ballance et al., U.S. Patent 6,090,210, as applied to claims 1-7, 9, 11-14, 39, 41-50, and 56-61 above, and further in view of Hassan et al., U.S. Patent 4,270,999.

Chang, Murugesh et al., Arami et al., Goodyear et al. and Ballance et al. are applied as above but do not expressly disclose that the on-axis and the off-axis outlets includes an interior orifice contoured to provide sonic or supersonic flow therethrough. Hassan et al. discloses an apparatus comprising a gas outlet contoured to provide sonic velocity flow in order to achieve uniform flow distribution of the gas to be injected. In view of this disclosure, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the apparatus of Chang modified by Murugesh et al. and Arami et al., Goodyear et al. or Ballance et al., so as to contour the interior orifice of the on-axis and the off-axis outlets to provide sonic or supersonic flow therethrough, in order to achieve uniform flow distribution of the gas to be injected.

Response to Arguments


Applicant's arguments with respect to claims 1-15 and 39-61 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Luz L. Alejandro whose telephone number is 571-272-1430. The examiner can normally be reached on Monday to Thursday from 7:30 to 6:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gregory L. Mills can be reached on 571-272-1439. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Luz L. Alejandro
Primary Examiner
Art Unit 1763

September 7, 2004